# Refine Search

Your wildcard search against 10000 terms has yielded the results below.

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The probable cause is use of unlimited truncation. Revise your search strategy to use limited truncation.

**Search Results -**

| Terms | Documents |
|---|---|
| L24 and (vehicle or car$ or automobile) | 5 |

**Database:**

US Pre-Grant Publication Full-Text Database
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**Search:** L25

Refine Search

Recall Text Clear Interrupt

**Search History**

**DATE: Tuesday, August 29, 2006** **Purge Queries** Printable Copy Create Case

| **Set Name** side by side | **Query** | **Hit Count** | **Set Name** result set |
|---|---|---|---|
| | *DB=PGPB,USPT,USOC,EPAB,JPAB,DWPI,TDBD; THES=ASSIGNEE; PLUR=YES; OP=OR* | | |
| L25 | L24 and (vehicle or car$ or automobile) | 5 | L25 |
| L24 | L23 and (coordinat$ with (abilit$ or capabilit$ or level$ or strength$ or amplitu$)) | 5 | L24 |
| L23 | l20 or l21 or l22 | 22 | L23 |
| | *DB=USPT; THES=ASSIGNEE; PLUR=YES; OP=OR* | | |
| L22 | (4884203 \| 5166881 \| 5575542 \| 4583611 \| 4953093)![PN] | 5 | L22 |
| | *DB=PGPB,USPT; THES=ASSIGNEE; PLUR=YES; OP=OR* | | |
| L21 | ("20030225495"\| "5794735")[PN] | 2 | L21 |
| L20 | ("20030225495"\| "5794735")[URPN] | 15 | L20 |

*DB=PGPB,USPT,USOC,EPAB,JPAB,DWPI,TDBD; THES=ASSIGNEE; PLUR=YES; OP=OR*

| | | | |
|---|---|---|---|
| L19 | L1 or l12 | 2 | L19 |
| *DB=PGPB; THES=ASSIGNEE; PLUR=YES; OP=OR* | | | |
| L18 | L12 and prov$.clm. | 1 | L18 |
| L17 | L12 and ((code or program$) ) | 1 | L17 |
| L16 | L12 and ((code or program$) and comput$) | 0 | L16 |
| L15 | L12 and ((code or program$) same comput$) | 0 | L15 |
| L14 | L12 and (coordinat$ with (abilit$ or capabilit$ or level$ or strength$ or amplitu$)) | 1 | L14 |
| L13 | L12 and (coordinat$ with (abilit$ or capabilit$ or level$ or strength or amplitud$)) | 1 | L13 |
| L12 | 20030225495 | 1 | L12 |
| *DB=USPT; THES=ASSIGNEE; PLUR=YES; OP=OR* | | | |
| L11 | L1 and output$ | 1 | L11 |
| L10 | L1 and system$ | 1 | L10 |
| L9 | L1 and sub$ | 0 | L9 |
| L8 | L1 and coord$ | 0 | L8 |
| L7 | L1 and brak$ | 1 | L7 |
| L6 | L1 and damp$ | 0 | L6 |
| L5 | L1 and (driv$ same gear$) | 0 | L5 |
| L4 | L1 and (driv same gear$) | 0 | L4 |
| L3 | L1 and (brak$ same gear$) | 0 | L3 |
| L2 | L1 and calculat$ | 1 | L2 |
| L1 | 5794735.pn. | 1 | L1 |

END OF SEARCH HISTORY

# Hit List

First Hit Your wildcard search against 10000 terms has yielded the results below.

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**Search Results** - Record(s) 1 through 5 of 5 returned.

☐ 1. Document ID: US 20030225495 A1

L25: Entry 1 of 5 File: PGPB Dec 4, 2003

PGPUB-DOCUMENT-NUMBER: 20030225495
PGPUB-FILING-TYPE: new
DOCUMENT-IDENTIFIER: US 20030225495 A1

TITLE: Complete vehicle control

PUBLICATION-DATE: December 4, 2003

self

INVENTOR-INFORMATION:

| NAME | CITY | STATE | COUNTRY |
|---|---|---|---|
| Coelingh, Erik | Olofstorp | | SE |
| Ekmark, Jonas | Olofstorp | | SE |
| Andersson, Mats | V. Frolunda | | SE |

US-CL-CURRENT: 701/48; 701/37, 701/41, 701/70

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments | Claims | KWIC | Draw De

☐ 2. Document ID: US 6856877 B2

self

L25: Entry 2 of 5 File: USPT Feb 15, 2005

US-PAT-NO: 6856877
DOCUMENT-IDENTIFIER: US 6856877 B2

TITLE: Integration of active assist and vehicle dynamics control and method

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments | Claims | KWIC | Draw De

☐ 3. Document ID: US 6816764 B2

self

L25: Entry 3 of 5 File: USPT Nov 9, 2004

US-PAT-NO: 6816764
DOCUMENT-IDENTIFIER: US 6816764 B2

TITLE: Suspension coordinator subsystem and method

| Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments | Claims | KWIC | Draw De |
|---|---|---|---|---|---|---|---|---|---|---|---|---|

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☐ 4. Document ID: US 6622074 B1

L25: Entry 4 of 5 File: USPT Sep 16, 2003

rely

US-PAT-NO: 6622074
DOCUMENT-IDENTIFIER: US 6622074 B1
**** See image for Certificate of Correction ****

TITLE: Vehicle motion control subsystem and method

| Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments | Claims | KWIC | Draw De |
|---|---|---|---|---|---|---|---|---|---|---|---|---|

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☐ 5. Document ID: US 6178371 B1

L25: Entry 5 of 5 File: USPT Jan 23, 2001

US-PAT-NO: 6178371
DOCUMENT-IDENTIFIER: US 6178371 B1

TITLE: Vehicle speed control system and method

| Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments | Claims | KWIC | Draw De |
|---|---|---|---|---|---|---|---|---|---|---|---|---|

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Clear | Generate Collection | Print | Fwd Refs | Bkwd Refs | Generate OACS

| Terms | Documents |
|---|---|
| L24 and (vehicle or car$ or automobile) | 5 |

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**Display Format:** - Change Format

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L18: Entry 1 of 1 File: PGPB Dec 4, 2003

DOCUMENT-IDENTIFIER: US 20030225495 A1
TITLE: Complete vehicle control

Pre-Grant Publication (PGPub) Document Number:
20030225495

CLAIMS:

1. A method of controlling a vehicle comprising: inputting an intended driving demand to a vehicle motion control subsystem, the intended driving demand requesting a vehicle behavior modification; proving a plurality of coordinator subsystems; providing at least one actuator control subsystem for each coordinator subsystem; outputting actuator capabilities of the at least one actuator control subsystem to an associated one of the plurality of coordinator subsystems; outputting coordinator capabilities of each coordinator subsystem to the vehicle motion control subsystem; calculating at least one coordinator demand signal with the vehicle motion control subsystem, the at least one coordinator demand signal being determined according to the coordinator capabilities and the intended driving demand; outputting the at least one coordinator demand signal to at least one of the coordinator subsystems; calculating at least one actuator demand signal with each of the at least one of the coordinator subsystems, the at least one actuator demand signal being determined according to the actuator capabilities and the at least one coordinator demand signal outputted to the at least one of the coordinator subsystems; and outputting the at least one actuator demand signal to the at least one actuator control subsystem; wherein a combination of each at least one actuator demand signal provides directions for the at least one actuator control subsystem to perform the vehicle behavior modification of the intended driving demand.

2. The method of controlling a vehicle of claim 1, further comprising: receiving at least one driver input from a driver of the vehicle; providing at least one active assist program having at least one active input, the at least one active assist program having an on setting wherein the at least one active assist program outputs at least one active input and an off setting wherein the at least one active assist program does not output at least one active input; and receiving at least one active input from the at least one active assist program if the at least one active assist program is in the on setting; wherein a combination of the at least one driver input and the at least one active input define the intended driving demand if the at least one active assist program is in the on setting and if the driver of the vehicle does not override the at least one active assist program; and wherein the at least one driver input defines the intended driving demand if the at least one active assist program is in the off setting or the driver of the vehicle overrides the at least one active assist program.

15. A method of controlling a vehicle comprising: receiving at least one driver input from a driver of the vehicle; providing at least one active assist program having at least one active input, the at least one active assist program having an on setting wherein the at least one active assist program outputs at least one

active input and an off setting wherein the at least one active assist program does not output at least one active input; inputting an intended driving demand for implementing a vehicle behavior modification into a vehicle motion control subsystem; proving an implementation subsystem; and outputting at least a portion of the intended driving demand from the vehicle motion control subsystem to the implementation subsystem; wherein the intended driving demand is derived from a combination of the at least one driver input and the at least one active input if the at least one active assist program is in the on setting and if the driver of the vehicle does not overrule the at least one active assist program, otherwise the intended driving demand is derived from the at least one driver input.

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**End of Result Set**

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L25: Entry 5 of 5 File: USPT Jan 23, 2001

US-PAT-NO: 6178371
DOCUMENT-IDENTIFIER: US 6178371 B1

TITLE: Vehicle speed control system and method

DATE-ISSUED: January 23, 2001

INVENTOR-INFORMATION:

| NAME | CITY | STATE | ZIP CODE | COUNTRY |
|---|---|---|---|---|
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| Cullen; Michael John | Northville | MI | | |
| Hippley; Richard John | Canton | MI | | |

ASSIGNEE-INFORMATION:

| NAME | CITY | STATE | ZIP CODE | COUNTRY | TYPE CODE |
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| Ford Global Technologies, Inc. | Dearborn | MI | | | 02 |

APPL-NO: 09/290916 [PALM]
DATE FILED: April 12, 1999

INT-CL-ISSUED: [07] B60T 8/32, G06F 7/00

INT-CL-CURRENT:

| TYPE | IPC | DATE |
|---|---|---|
| CIPS | B60 K 31/02 | 20060101 |
| CIPS | B60 K 31/04 | 20060101 |

US-CL-ISSUED: 701/93; 701/110, 123/339.12, 180/170
US-CL-CURRENT: 701/93; 123/339.12, 180/170, 701/110

FIELD-OF-CLASSIFICATION-SEARCH: 701/93, 701/96, 701/110, 701/94, 701/97, 701/70, 123/352, 123/339.22, 123/339.23, 123/339.19, 123/480, 123/350, 123/531, 123/339.12, 123/339.14, 180/170, 180/180, 180/197, 180/179, 180/171, 73/118.1
See application file for complete search history.

PRIOR-ART-DISCLOSED:

U.S. PATENT DOCUMENTS

Search Selected | Search ALL | Clear

| PAT-NO | ISSUE-DATE | PATENTEE-NAME | US-CL |
|---|---|---|---|

| | | | | |
|---|---|---|---|---|
| ☐ | 4771848 | September 1988 | Namba et al. | 180/197 |
| ☐ | 4843553 | June 1989 | Ohata | 701/93 |
| ☐ | 4862367 | August 1989 | Tada et al. | 701/93 |
| ☐ | 4951627 | August 1990 | Watanabe et al. | 477/111 |
| ☐ | 4967358 | October 1990 | Etoh | 701/97 |
| ☐ | 5018383 | May 1991 | Togai et al. | 73/118.1 |
| ☐ | 5375574 | December 1994 | Tomisawa et al. | 123/339.22 |
| ☐ | 5392215 | February 1995 | Morita | 701/94 |
| ☐ | 5479898 | January 1996 | Cullen et al. | 123/350 |
| ☐ | 5483941 | January 1996 | Cullen et al. | 123/481 |
| ☐ | 5492094 | February 1996 | Cullen et al. | 123/396 |
| ☐ | 5508923 | April 1996 | Ibamoto et al. | 701/70 |
| ☐ | 5646851 | July 1997 | O'Connell et al. | 701/93 |
| ☐ | 5657230 | August 1997 | Hess et al. | 701/104 |
| ☐ | 5778331 | July 1998 | Leising et al. | 701/66 |
| ☐ | 5794735 | August 1998 | Sigl | 180/170 |
| ☐ | 6006724 | December 1999 | Takahashi et al. | 123/339.19 |
| ☐ | 6039023 | March 2000 | Cullen et al. | 123/339.23 |
| ☐ | 6061623 | May 2000 | Hippley et al. | 701/93 |
| ☐ | 6078859 | June 2000 | Jastrzebski et al. | 701/93 |

ART-UNIT: 361

PRIMARY-EXAMINER: Louis-Jacques; Jacques H.

ATTY-AGENT-FIRM: Russell; John D.

ABSTRACT:

A speed control method for vehicles having an internal combustion engine smoothly controls engine torque to control vehicle speed. Torque is controlled via airflow in a first torque control range. Torque is controlled via a coordination of air/fuel ratio, ignition timing, and cylinder deactivation is a second torque control range. The torque range is selected based on the required airflow to deliver the required torque. If the required airflow is less than a lower allowable value, then the airflow is fixed at this lower allowable value and the second range is selected. Otherwise, the first range is selected.

19 Claims, 6 Drawing figures

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L25: Entry 1 of 5 File: PGPB Dec 4, 2003

PGPUB-DOCUMENT-NUMBER: 20030225495
PGPUB-FILING-TYPE: new
DOCUMENT-IDENTIFIER: US 20030225495 A1

TITLE: Complete vehicle control

PUBLICATION-DATE: December 4, 2003

INVENTOR-INFORMATION:

| NAME | CITY | STATE | COUNTRY |
|---|---|---|---|
| Coelingh, Erik | Olofstorp | | SE |
| Ekmark, Jonas | Olofstorp | | SE |
| Andersson, Mats | V. Frolunda | | SE |

ASSIGNEE-INFORMATION:

| NAME | CITY | STATE | COUNTRY | TYPE CODE |
|---|---|---|---|---|
| Ford Global Technologies, Inc. | Dearborn | MI | | 03 |

APPL-NO: 10/063953 [PALM]
DATE FILED: May 29, 2002

INT-CL-PUBLISHED: [07] G06F 19/00

INT-CL-CURRENT:

| TYPE | IPC | DATE |
|---|---|---|
| CIPS | B62 D 6/00 | 20060101 |
| CIPS | B60 G 17/015 | 20060101 |
| CIPS | B60 G 17/0195 | 20060101 |

US-CL-PUBLISHED: 701/48; 701/37, 701/41, 701/70
US-CL-CURRENT: 701/48; 701/37, 701/41, 701/70

REPRESENTATIVE-FIGURES: 1A

ABSTRACT:

A vehicle control system (10) including a vehicle motion control subsystem (12) that has an input receiving an intended driving demand (14) and a plurality of coordinator subsystems (16) for coordinating actuators of the vehicle. The vehicle motion control subsystem (12) communicates with the coordinator subsystems (16) to determine whether a single coordinator subsystem (16) can carry out the intended driving demand (14). The vehicle motion control subsystem (12) will distribute demand signals among one or more of the coordinator subsystems (16) to allow the vehicle to implement the intended driving demand (14).

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L13: Entry 1 of 1    File: PGPB    Dec 4, 2003

DOCUMENT-IDENTIFIER: US 20030225495 A1
TITLE: Complete vehicle control

Pre-Grant Publication (PGPub) Document Number:
20030225495

Summary of Invention Paragraph:
[0003] Heretofore, total control structures for motor vehicles have included coordinating elements which convert a command from a higher hierarchical level into commands for elements of a lower hierarchical level. The contents of the commands, which are transmitted from above to below in the hierarchical structure, define physical variables that determine the interfaces between the individual hierarchical levels. The command flow is only from a higher hierarchical level to a lower hierarchical level. U.S. Pat. Nos. 5,351,776 and 6,154,688 disclose control systems wherein the command flows only from the higher hierarchical level to the lower hierarchical level. However, the aforementioned control systems do not revise their commands to the lower hierarchical levels when the actuators being commanded by the lower hierarchical levels cannot carry out the commands.

Summary of Invention Paragraph:
[0005] One aspect of the present invention is to provide a method of controlling a vehicle. The method includes the step of inputting an intended driving demand to a vehicle motion control subsystem, with the intended driving demand requesting a vehicle behavior modification. The method also includes the steps of proving a plurality coordinator subsystems, providing at least one actuator control subsystem for each coordinator subsystem, outputting actuator capabilities of the at least one actuator control subsystem to an associated one of the plurality of coordinator subsystems, and outputting coordinator capabilities of each coordinator subsystem to the vehicle motion control subsystem. The method further includes the step of calculating at least one coordinator demand signal with the vehicle motion control subsystem, with the at least one coordinator demand signal being determined according to the coordinator capabilities and the intended driving demand. The method also includes the step of outputting the at least one coordinator demand signal to at least one of the coordinator subsystems. The method further includes the step of calculating the at least one coordinator demand signal with each of the at least one of the coordinator subsystems, with the at least one actuator demand signal being determined according to the actuator capabilities and the at least one coordinator demand signal. The method also includes the step of outputting the at least one actuator demand signal to the at least one actuator control subsystem. A combination of each at least one actuator demand signal provides directions for the at least one actuator control subsystem to perform the vehicle behavior modification of the intended driving demand.

Summary of Invention Paragraph:
[0006] Another aspect of the present invention is to provide a vehicle control system comprising a vehicle motion control subsystem, a plurality of coordinator subsystems and at least one actuator control subsystem. The vehicle motion control subsystem has a control input and a control output, with the control input

communicating an intended driving demand to the vehicle motion control subsystem. The intended driving demand requests a vehicle behavior modification. Each coordinator subsystem includes a coordinator input and a coordinator output, with each coordinator subsystem communicating coordinator capabilities of the coordinator subsystem to the system input of the vehicle motion control subsystem. At least one actuator control subsystem is provided for each coordinator subsystem. Each actuator control subsystem has an actuator output communicating actuator capabilities of the actuator control subsystem to the coordinator input of an associated one of the plurality of coordinator subsystems. The vehicle motion control subsystem calculates at least one coordinator demand signal, with the at least one coordinator demand signal being determined according to the coordinator capabilities and the intended driving demand. The vehicle motion control subsystem also outputs the at least one coordinator demand signal to the coordinator input of at least one of the coordinator subsystems. Furthermore, each coordinator subsystem calculates at least one actuator demand signal, with the at least one actuator demand signal being determined according to the actuator capabilities and the at least one coordinator demand signal. Additionally, each coordinator subsystem outputs the at least one actuator demand signal to at least one actuator control subsystem. A combination of each at least one actuator demand signal provides directions for the at least one actuator control subsystem to perform the vehicle behavior modification of the intended driving demand.

Detail Description Paragraph:
[0017] Referring to FIG. 1A, reference number 10 generally designates a first portion of a vehicle control system embodying the present invention. In the illustrated example, the first portion 10 of the vehicle control system includes a vehicle motion control subsystem 12 that has an input receiving an intended driving demand 14 and a plurality of coordinator subsystems 16 for coordinating actuators of the vehicle. The vehicle motion control subsystem 12 communicates with the coordinator subsystems 16 to determine the capabilities of the coordinator subsystems 16 for carrying out the intended driving demand 14. The vehicle motion control subsystem 12 will distribute demand signals among one or more of the coordinator subsystems 16 to allow the vehicle to implement the intended driving demand 14.

Detail Description Paragraph:
[0018] In the illustrated example, the vehicle control system comprises a hierarchy including five tiers of control levels for controlling vehicle behavior modifications. FIG. 1A illustrates the input from the top two control tiers and the bottom three control: tiers. The third level control tier includes the vehicle motion control subsystem 12 for overall control of the six degrees of motion of the vehicle. The top two control tiers produce the intended driving demand 14 that is input into the vehicle motion control subsystem 12. The fourth level control tier includes the coordinator subsystems 16. The coordinator subsystems can include a steering coordinator subsystem 18 for controlling steering of the vehicle, a drive train and brakes coordinator subsystem 20 for controlling a drive train and brakes of the vehicle, and a suspension coordinator subsystem 22 for controlling a suspension of the vehicle. All of the coordinator subsystems 16 of the fourth level control tier communicate with the vehicle motion control subsystem 12. The fifth level control tier includes actuator control subsystems 26 for controlling individual actuators of the steering coordinator subsystem 18, the drive train and brakes coordinator subsystem 20, and the suspension coordinator subsystem 22. Each actuator control subsystem 26 communicates with one of the coordinator subsystems 16.

Detail Description Paragraph:
[0022] In the illustrated example, the coordinator subsystems 16 communicate with the vehicle motion control subsystem 12 for receiving inputs for carrying out the intended driving demand 14. The coordinator subsystems 16 preferably include the steering coordinator subsystem 18, the drive train and brakes coordinator subsystem

20, and the suspension coordinator subsystem 22. Each of the coordinator subsystems 16 include an input that receives a signal from the vehicle motion control subsystem 12 commanding the coordinator subsystem 16 to implement a particular vehicle behavior modification. Therefore, the steering coordinator subsystem 18 receives a steering behavior modification demand signal conveying a steering behavior modification demand from the vehicle motion control subsystem 12. The steering behavior modification demand instructs the steering coordinator subsystem 18 to make a steering behavior modification (e.g., steer the vehicle in a certain lateral direction). Likewise, the drive train and brakes coordinator subsystem 20 receives a drive train and brakes behavior modification demand signal conveying a drive train and brakes behavior modification demand from the vehicle motion control subsystem 12. The drive train and brakes behavior modification demand instructs the drive train and brakes coordinator subsystem 20 to make a drive train and brakes behavior modification (e.g., move the vehicle in a certain longitudinal direction). Moreover, the suspension coordinator subsystem 22 receives a suspension behavior modification demand signal conveying a suspension behavior modification demand from the vehicle motion control subsystem 12. The suspension behavior modification demand instructs the suspension coordinator subsystem 22 to make a suspension behavior modification (e.g., manipulate the vehicle in a certain vertical (heave) direction). Each behavior modification demand of the coordinator subsystems 16 can also affect the motion of the vehicle in other directions. For example, the steering coordinator subsystem 18 can affect the yaw motion of the vehicle by turning the front wheels of the vehicle and can affect the roll motion of the vehicle by turning (thereby causing the side of the vehicle with the smaller turning radius to roll upward). As additional examples, the drive train and brakes coordinator subsystem 20 can affect the yaw motion by braking only one side of the vehicle and the suspension coordinator subsystem 22 can affect the longitudinal motion of the vehicle by altering the suspension of the vehicle to provide for improved traction. Furthermore, as discussed in more detail below, each coordinator subsystem 16 also provides an output to the vehicle motion control subsystem 12 for communicating capabilities of the coordinator subsystems 16. The capabilities of the coordinator subsystems 16 are the combination of the actuator control subsystems 26 communicating with an associated coordinator subsystem 16. Although three coordinator subsystems 16 are shown and described herein, it is contemplated that any number of coordinator subsystems 16 can be used in the vehicle control system.

Detail Description Paragraph:
[0025] The illustrated suspension coordinator subsystem 22 apportions the suspension behavior modification demand from the vehicle motion control subsystem 12 to a damping control subsystem 42 controlling damping of the suspension of the vehicle, a roll control subsystem 44 controlling roll of the vehicle and a leveling control subsystem 46 controlling a level of the vehicle. The damping control subsystem 42 controlling damping of the suspension of the vehicle, the roll control subsystem 44 and the leveling control subsystem 46 primarily move the vehicle in the heave direction as well as affect motion of the vehicle in other directions. The actuator control subsystems 26 listed above are illustrative, and not exhaustive, of the actuator control subsystems 26 that can be used in the vehicle control system. For example, a tire pressure control subsystem functionally located below the suspension coordinator subsystem 22 can also be employed.

Detail Description Paragraph:
[0036] The illustrated vehicle control system of the present invention enhances the performance of the vehicle by distributing commands from the vehicle motion control subsystem 12 to the coordinator subsystems 16 based upon physical capabilities of the actuator control subsystems 26. Referring to FIGS. 5A and 5B, a method 50 of controlling a vehicle with the vehicle control system is shown. Beginning at step 52 of the method 50 of controlling the vehicle, the driver inputs from the driver 11 of the vehicle are inputted into the driver subsystem 15. The driver inputs are processed as discussed above and then sent to the active assist subsystem 17 at

step 54.

Detail Description Paragraph:
[0038] The next three steps in the method of controlling a vehicle occur continuously, even if the intended driving demand 14 is not being input into the vehicle motion control subsystem 12. First, the vehicle state measurements are inputted into the vehicle motion control subsystem 12 from the vehicle state estimator 28 and data therefrom is transferred to each control tier in the vehicle control system at step 62. Second, the coordinator subsystems 16 will determine their capabilities at step 64. As discussed in more detail below, the capabilities of each coordinator subsystem 16 are a combination of all of the capabilities of the actuator control subsystems 26 functionally located under each coordinator subsystem 16 as determined by the data of the vehicle state measurements and measurements from actuator state estimators communicating with each actuator control subsystem 26. For example, a first one of the coordinator subsystems 16 can be the drive train and brakes coordinator subsystem 20 determining that it is capable of providing up to 3.0 Newton meters of braking wheel torque as measured by a combination of the braking wheel torque capabilities of the actuator control subsystems 26 communicating with the drive train and brakes coordinator subsystem 20. Although the drive train and brakes coordinator subsystem 20 is used in the above example, the coordinator subsystems 16 in step 64 could be any of the coordinator subsystems 16. Third, the coordinator subsystems 16 will output their capabilities to the vehicle motion control subsystem 12 at step 66.

Detail Description Paragraph:
[0039] After the intended driving demand 14 has been input into the vehicle motion control subsystem 12 at step 58 or 60, the vehicle motion control subsystem 12 will calculate at least one of a first demand signal, a second demand signal and a third demand signal at step 68. The calculation at step 68 is dependent on the capabilities of the first, second and third coordinator subsystems 16. The demand signals to the coordinator subsystems 16 will preferably not demand more from the coordinator subsystems 16 than a particular coordinator subsystem 16 is capable of providing as determined by the capability of the particular coordinator subsystem 16. For example, if the steering coordinator subsystem 18 is only capable of providing 3.0 Newton meters of yaw torque by altering the angles of the wheels and the intended driving demand requires 3.5 Newton meters of yaw torque, the vehicle motion control subsystem 12 will calculate a first demand signal for the steering coordinator subsystem 18 for 3.0 Newton meters (or less) of yaw torque and will send out a second demand signal to the drive train and brakes coordinator 20 requesting 0.5 Newton meters of yaw torque by instructing the drive train and brakes coordinator 20 to brake (braking wheel torque) one side of the vehicle (if possible). Therefore, the vehicle motion control subsystem 12 can output the first demand signal, the second demand signal and/or the third demand signal to the steering coordinator subsystem 18, the drive train and brakes coordinator subsystem 20 and the suspension coordinator subsystem 22, respectively, to accomplish the 3.5 Newton meters of yaw torque. Preferably, the vehicle motion control subsystem 12 will send out demand signals that do not require the coordinator subsystems 16 to perform up to their full capabilities. Therefore, the demand signals sent to each coordinator subsystem 16 will depend on the capabilities of the coordinator subsystem 16 and/or the capabilities of the other coordinator subsystems 16. The demand signal sent to a first coordinator subsystem 16, when more than one demand signal is calculated, will depend on the demand signal sent to a second coordinator subsystem 16, which depends on the capabilities of the second coordinator subsystem 16.

Detail Description Paragraph:
[0041] The illustrated suspension coordinator subsystem 22 of the present invention also enhances the performance of the suspension of the vehicle by distributing commands from the suspension coordinator subsystem 22 to the actuator control subsystems 26 functionally located below the suspension coordinator subsystem 22

based upon physical capabilities of the actuator control subsystems 26. Referring to FIG. 6, a method 200 of controlling a suspension of a vehicle with the suspension coordinator subsystem 22 subsystem is shown. Beginning at step 202 of the method 200 of controlling the suspension of the vehicle, the suspension behavior modification demand signal is inputted into the suspension coordinator subsystem 22. The suspension behavior modification demand signal is a signal sent to the suspension coordinator subsystem 22 directing the suspension coordinator subsystem 22 to perform a particular behavior modification of the suspension of the vehicle (i.e., the suspension behavior modification).

Detail Description Paragraph:
[0042] The actuator control subsystems 26 receive the vehicle state measurements from the vehicle state estimator 28 (via the motion control subsystem 12 and the suspension coordinator subsystem 22) that provide the state of the vehicle and actuator state measurements from an actuator state estimator that provide the state of the actuators at step 204. As seen in FIG. 1, the vehicle state measurements are preferably transferred to the actuator control subsystems 26 through the vehicle motion control subsystem 12 and the suspension coordinator subsystem 22, although it is contemplated that the vehicle state measurements could be directly inputted into the actuator control subsystems 26. The actuator state measurements are preferably inputted directly into the actuator control subsystems 26. After the vehicle state measurements and actuator state measurements are inputted into the actuator control subsystems 26, the actuator control subsystems 26 will determine their capabilities to perform functions with the vehicle in the state of the vehicle state measurements and actuator state measurements at step 206. The vehicle state measurements are used to determine the capabilities of the actuator control subsystems 26 because the vehicle state measurements will communicate the speed of the vehicle, the movement of the vehicle in six directions, etc. to the actuator control subsystems 26, all of which are used along with the actuator state measurements (which provide the current state of the actuators of and controlled by the actuator control subsystems 26) to determine the capabilities of the actuator control subsystems 26. For example, a first actuator control subsystem 26 can be the leveling control subsystem 46 determining that it is capable of providing up to 3.0 Newtons of vertical force as determined by the load of the vehicle (a vehicle state measurement) and possible air input into an air-suspension level-control system (an actuator state measurement). Although the leveling actuator control subsystem 46 is used in the above example, the actuator control subsystem 26 could be any of the actuator control subsystems 26 under the suspension coordinator subsystem 22. Furthermore, although the step 202 of inputting the suspension behavior modification demand into the suspension coordinator subsystem 22 is shown as occurring before the step 204 of receiving the vehicle state measurements and the actuator state measurements by the first actuator control subsystem 26 and the step 206 of determining the actuator capabilities of the actuator control subsystems 26, steps 204 and 206 can occur simultaneously to or before the step 202 of inputting the suspension behavior modification demand into the suspension coordinator subsystem 22. Preferably, both steps 204 and 206 will occur continuously in the vehicle control system.

Detail Description Paragraph:
[0043] After the actuator control subsystems 26 have determined their capabilities, each actuator control subsystem 26 will output a capability signal to the suspension coordinator subsystem 22 communicating the capabilities of each actuator control subsystem 26 at step 208. At this point, the suspension coordinator subsystem 22 will then calculate at least one partial suspension behavior modification demand signal at step 210 (along with combining the capabilities of the actuator control system 26 to form the coordinator capability of the suspension coordinator subsystem 22 for reporting to the vehicle motion control subsystem 12 as discussed above). A first partial suspension behavior modification demand signal will tell a first actuator control subsystem 26 to perform within its first capabilities. Likewise, a second partial suspension behavior modification demand

signal will tell a second actuator control subsystem 26 to perform within its second capabilities. Moreover, a third partial suspension behavior modification demand signal will tell a third actuator control subsystem 26 to perform within its third capabilities. Consequently, the first partial suspension behavior modification demand signal, the second partial suspension behavior modification demand signal and/or the third partial suspension behavior modification demand signal will provide directions for a first actuator control subsystem 26, the second actuator control subsystem 26 and/or the third actuator control subsystem 26, respectively, to perform the suspension behavior modification of the suspension behavior modification demand signal. Furthermore, the first partial suspension behavior modification demand signal, the second partial suspension behavior modification demand signal and the third partial suspension behavior modification demand signal are therefore calculated according to the first capabilities of the first actuator control subsystem 26, the second capabilities of the second actuator control subsystem 26 and/or the third capabilities of the third actuator control subsystem 26. For example, if the suspension behavior modification demand signal requires more from a single actuator control subsystem than it is capable of providing (as determined by its capabilities), more than one partial suspension behavior modification demand signal will be calculated, with a first partial suspension behavior modification demand signal being determined according to the capabilities of a first actuator control system (i.e., requesting the first actuator control system to perform within its capabilities) and a second partial suspension behavior modification demand signal that depends on the capabilities of the first actuator control subsystem (a suspension behavior modification demand of the suspension behavior modification demand signal remaining after the first partial suspension behavior modification demand signal is removed).

Detail Description Paragraph:
[0045] The illustrated drive train and brakes coordinator subsystem 22 of the present invention also enhances the performance of the drive train and brakes of the vehicle by distributing commands from the drive train and brakes coordinator subsystem 22 to the actuator control subsystems 26 based upon physical capabilities of the actuator control subsystems 26 functionally located below the drive train and brakes coordinator subsystem 22. Referring to FIG. 7, a method 300 of controlling a drive train and brakes of a vehicle with the drive train and brakes coordination 22 subsystem is shown. Beginning at step 302 of the method 300 of controlling the drive train and brakes of the vehicle, the drive train and brakes behavior modification demand signal is inputted into the drive train and brakes coordinator subsystem 22. The drive train and brakes behavior modification demand signal is a signal sent to the drive train and brakes coordinator subsystem 22 directing the drive train and brakes coordinator subsystem 22 to perform a particular behavior modification of the drive train and brakes of the vehicle (i.e., the drive train and brakes behavior modification).

Detail Description Paragraph:
[0046] The actuator control subsystems 26 receive the vehicle state measurements from the vehicle state estimator 28 (via the motion control subsystem 12 and the drive train and brakes coordinator subsystem 22) that provide the state of the vehicle and actuator state measurements from an actuator state estimator that provide the state of the actuators at step 304. As seen in FIG. 1, the vehicle state measurements are preferably transferred to the actuator control subsystems 26 through the vehicle motion control subsystem 12 and the drive train and brakes coordinator subsystem 22, although it is contemplated that the vehicle state measurements could be directly inputted into the actuator control subsystems 26. The actuator state measurements are preferably inputted directly into the actuator control subsystems 26. After the vehicle state measurements and actuator state measurements are inputted into the actuator control subsystems 26, the actuator control subsystems 26 will determine their capabilities to perform functions with the vehicle in the state of the vehicle state measurements and actuator state measurements at step 306. The vehicle state measurements are used to determine the

capabilities of the actuator control subsystems 26 because the vehicle state measurements will communicate the speed of the vehicle, the movement of the vehicle in six directions, etc. to the actuator control subsystems 26, all of which are used along with the actuator state measurements (which provide the current state of the actuators of and controlled by the actuator control subsystems 26) to determine the capabilities of the actuator control subsystems 26. For example, a first actuator control subsystem 26 can be the engine control subsystem 36 determining that it is capable of providing up to 3.0 Newton meters of wheel torque as determined by the speed of the vehicle (a vehicle state measurement) and possible fuel input into an engine (an actuator state measurement). Although the engine control subsystem 36 is used in the above example, the actuator control subsystem 26 could be any of the actuator control subsystems 26 under the drive train and brakes coordinator subsystem 22. Furthermore, although the step 302 of inputting the drive train and brakes behavior modification demand into the drive train and brakes coordinator subsystem 22 is shown as occurring before the step 304 of receiving the vehicle state measurements and the actuator state measurements by the first actuator control subsystem 26 and the step 306 of determining the actuator capabilities of the actuator control subsystems 26, steps 304 and 306 can occur simultaneously to or before the step of inputting the drive train and brakes behavior modification demand into the drive train and brakes coordinator subsystem 22. Preferably, both steps 304 and 306 will occur continuously in the vehicle control system.

Detail Description Paragraph:
[0047] After the actuator control subsystems 26 have determined their capabilities, each actuator control subsystem 26 will output a capability signal to the drive train and brakes coordinator subsystem 22 communicating the capabilities of each actuator control subsystem 26 at step 308. At this point, the drive train and brakes coordinator subsystem 22 will then calculate at least one partial drive train and brakes behavior modification demand signal at step 310 (along with combining the capabilities of the actuator control system 26 to form the coordinator capability of the drive train and brakes coordinator subsystem 22 for reporting to the vehicle motion control subsystem 12 as discussed above). A first partial drive train and brakes behavior modification demand signal will tell a first actuator control subsystem 26 to perform within its first capabilities. Likewise, a second partial drive train and brakes behavior modification demand signal will tell a second actuator control subsystem 26 to perform within its second capabilities. Moreover, a third partial drive train and brakes behavior modification demand signal will tell a third actuator control subsystem 26 to perform within its third capabilities. Consequently, the first partial drive train and brakes behavior modification demand signal, the second partial drive train and brakes behavior modification demand signal and/or the third partial drive train and brakes behavior modification demand signal will provide directions for a first actuator control subsystem 26, the second actuator control subsystem 26 and/or the third actuator control subsystem 26, respectively, to perform the drive train and brakes behavior modification of the drive train and brakes behavior modification demand signal. Furthermore, the first partial drive train and brakes behavior modification demand signal, the second partial drive train and brakes behavior modification demand signal and the third partial drive train and brakes behavior modification demand signal are therefore calculated according to the first capabilities of the first actuator control subsystem 26, the second capabilities of the second actuator control subsystem 26 and the third capabilities of the third actuator control subsystem 26. For example, if the drive train and brakes behavior modification demand signal requires more from a single actuator control subsystem than it is capable of providing (as determined by its capabilities), more than one partial drive train and brakes behavior modification demand signal will be calculated, with a first partial drive train and brakes behavior modification demand signal being determined according to the capabilities of a first actuator control system (i.e., requesting the first actuator control system to perform within its capabilities) and a second partial drive train and brakes behavior

modification demand signal that depends on the capabilities of the first actuator control subsystem (a drive train and brakes behavior modification demand of the drive train and brakes behavior modification demand signal remaining after the first partial drive train and brakes behavior modification demand is removed).

CLAIMS:

1. A method of controlling a vehicle comprising: inputting an intended driving demand to a vehicle motion control subsystem, the intended driving demand requesting a vehicle behavior modification; proving a plurality of coordinator subsystems; providing at least one actuator control subsystem for each coordinator subsystem; outputting actuator capabilities of the at least one actuator control subsystem to an associated one of the plurality of coordinator subsystems; outputting coordinator capabilities of each coordinator subsystem to the vehicle motion control subsystem; calculating at least one coordinator demand signal with the vehicle motion control subsystem, the at least one coordinator demand signal being determined according to the coordinator capabilities and the intended driving demand; outputting the at least one coordinator demand signal to at least one of the coordinator subsystems; calculating at least one actuator demand signal with each of the at least one of the coordinator subsystems, the at least one actuator demand signal being determined according to the actuator capabilities and the at least one coordinator demand signal outputted to the at least one of the coordinator subsystems; and outputting the at least one actuator demand signal to the at least one actuator control subsystem; wherein a combination of each at least one actuator demand signal provides directions for the at least one actuator control subsystem to perform the vehicle behavior modification of the intended driving demand.

7. The method of controlling a vehicle of claim 6, wherein: the coordinator capabilities for the associated one of the plurality of coordinator subsystems are determined according to the actuator capabilities of the at least one actuator control subsystem outputting the actuator capabilities to the associated one of the plurality of coordinator subsystems.

8. A vehicle control system comprising: a vehicle motion control subsystem having a control input and a control output, the control input communicating an intended driving demand to the vehicle motion control subsystem, the intended driving demand requesting a vehicle behavior modification; a plurality of coordinator subsystems, each coordinator subsystem including a coordinator input and a coordinator output, each coordinator subsystem communicating coordinator capabilities of the coordinator subsystem to the system input of the vehicle motion control subsystem; and at least one actuator control subsystem for each coordinator subsystem, each actuator control subsystem having an actuator output communicating actuator capabilities of the actuator control subsystem to the coordinator input of an associated one of the plurality of coordinator subsystems; wherein the vehicle motion control subsystem calculates at least one coordinator demand signal, the at least one coordinator demand signal being determined according to the coordinator capabilities and the intended driving demand; wherein the vehicle motion control subsystem outputs the at least one coordinator demand signal to the coordinator input of at least one of the coordinator subsystems; wherein each coordinator subsystem calculates at least one actuator demand signal, the at least one actuator demand signal being determined according to the actuator capabilities and the at least one coordinator demand signal outputted to the at least one of the coordinator subsystems; wherein each coordinator subsystem outputs the at least one actuator demand signal to at least one actuator control subsystem; and wherein a combination of each at least one actuator demand signal provides directions for the at least one actuator control subsystem to perform the vehicle behavior modification of the intended driving demand.

14. The vehicle control system of claim 13, wherein: the coordinator capabilities

for the associated one of the plurality of coordinator subsystems are determined according to the actuator capabilities of the at least one actuator control subsystem outputting the actuator capabilities to the associated one of the plurality of coordinator subsystems.

16. The method of controller a vehicle of claim 15, wherein: the implementation subsystem includes a plurality coordinator subsystems and at least one actuator control subsystem for each coordinator subsystem; and further including the steps of: outputting actuator capabilities of the at least one actuator control subsystem to an associated one of the plurality of coordinator subsystems; outputting coordinator capabilities of each coordinator subsystem to the vehicle motion control subsystem; calculating at least one coordinator demand signal with the vehicle motion control subsystem, the at least one coordinator demand signal being determined according to the coordinator capabilities and the intended driving demand; the step of outputting at least a portion of the intended driving demand includes outputting the at least one coordinator demand signal to at least one of the coordinator subsystems; calculating at least one actuator demand signal with each of the at least one of the the coordinator subsystems, the at least one actuator demand signal being determined according to the actuator capabilities and the at least one coordinator demand signal outputted to the at least one of the coordinator subsystem; and outputting the at least one actuator demand signal to the at least one actuator control subsystem; wherein the at least one actuator demand signal provides directions for the at least one actuator control subsystem to perform the vehicle behavior modification of the intended driving demand.

18. The method of controlling a vehicle of claim 17, wherein: the coordinator capabilities for the associated one of the plurality of coordinator subsystems are determined according to the actuator capabilities of the at least one actuator control subsystem outputting the actuator capabilities to the associated one of the plurality of coordinator subsystems.

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